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Journal as a Sel-reinforcing Mechanism

by

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Abstract

We look at the journal publishing activity from an industrial organization perspective. We show that if product differentiation is not too large and refereeing not too noisy, then journal reputation is a path-dependent process, that is, the reputation of a journal converges to some value which depends on the (random) pattern of submissions during the journals' first periods of life. Empirical evidence of path-dependence for Economics periodicals is provided. Next, we explore the implications of these results in a model of sequential choice of scope of a new journal. The path-dependent nature of journal reputation leads to a bias towards specialization, which in turn implies that the increase in the number of publications is greater than the increase in the number of "good" papers written. J.E.L. classification numbers: L10, L82.

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1 Introduction

It is commonly agreed among scholars that the number of professional publications, especially journals, has increased dramatically in recent years. At the same time, each new journal seems to be increasingly specialized.

There are several factors which may account for this phenomenon. The total number of scholars has increased and so has total research output in terms of potential publications. Moreover, changes in promotion and tenure criteria have led to an increase in number and narrowing in scope of the papers produced by scholars.

In this paper, we look at the professional journal publishing activity from an industrial organization perspective.[1] The goal is to find whether there exists an endogenous mechanism –as opposed to the exogenous factors listed in the preceding paragraph— which can explain the rapid growth in the number of periodicals.

We consider a stylized oligopoly model in which publishers supply journals/demand papers and scholars supply papers/demand publication outlets. The other part of the market, namely demand for subscriptions, is not explicitly modeled; we simply assume that each journal's payoff is a function of its quality characteristics.

A realistic model of the periodicals "market" must account for product differentiation. Not all journals are equal: *Physics Letters*, for example. is a different "product" than the *American Economic Review*. This is usually referred to as *horizontal product differentiation.* Moreover, the *American Economic Review* is a different "product" than the *South African Journal of Economics*: while both have the same publication focus, one is said to be a "better" journal that the other. This is usually referred to as *vertical product differentiation.*

The industrial organization literature on product differentiation is now quite extensive. Most of the models which have been developed are a variant of the following two-stage game: in a first stage, firms choose their "location" (e.g.. quality) in the product space; in a second stage, firms compete in prices, given locations. Product quality (i.e., location) is usually viewed from one or both of the perspectives referred to above (horizontal and vertical product differentiation).[2]

There are, however, two important aspects of the professional journals "market" that the product differentiation models seem not to have captured.

[1] For simplicity, we will will designate professional journals by "periodicals" or "journals." It will become clear that the important feature which distinguishes professional journals from other types of publications is that they are based on *contributed* (and refereed) papers.

[2] See Neven and Thisse (1989) and references therein for models encompassing both horizontal and vertical product differentiation.

The first aspect is that vertical quality (the reputation of a journal) is mainly an endogenous, rather than exogenous, variable. What makes a good journal is the quality of the articles that it publishes. Authors send their good papers to the journals they believe to be better, usually *the journals that have published good papers in the past.* Although the quality of the editorial board and other exogenous factors may have some influence, journal reputation is, to a very large extent, endogenously determined.

The second aspect which is not captured by the models of product differentiation is that horizontal quality in a journal is defined not only by its "location" but also by its scope. In particular, one can distinguish "general" and "specialized" journals.

In this paper, we develop models which incorporate both of these peculiar features of the periodicals market.

In the next section, we present a model of a journal "duopoly" in which reputation is an endogenous variable. In particular, we assume that the reputation of a journal is an increasing function of its past ability to publish "good" articles. That is, reputation is a self-reinforcing mechanism. We show that if the degree of product differentiation is sufficiently small then reputation is a path-dependent process: the reputation of a journal converges almost surely to either the greatest or the lowest possible value, depending on the (random) pattern of submissions during the journals' first periods of life. We also consider two extensions: the possibility of noise in refereeing and the case of an n-journal "oligopoly."

In Section 3, some empirical evidence is presented based on citation data from a sample of economics journals. The results are consistent with the hypothesis that reputation is a path-dependent process.

In Section 4, we explore some of the implications of these results. First, we consider the strategic choice of scope of a new journal under the assumption of sequential entry, and show that the path-dependent nature of reputation implies a bias towards specialization. The idea is that choosing a narrow scope for a new journal is a way of compensating for the first-mover advantage of earlier entrants, which are significant precisely due to the reputation factor. We then argue that specialization should lead to higher acceptance rates. As a result, starting from a situation with mostly general journals, one should observe an increase in the number of publications which is greater (i.e., has a higher growth rate) than the increase in the number of papers written.

Section 5 concludes the paper.

Before proceding to the next section, we should make reference to the related literature on the hypothesis of cumulative causation in *scientist* reputation, the so-called "Mathew effect in science." Cumulative causation was first explained by the fact that scientists tend to choose their reading matter based on an author's preceding reputation (Merton, 1968). Other explanations were advanced, some considering the effect of allocating scarce research resources on the basis of reputation. In all cases, the effect of cumulative causation is that the distribution of scientists' reputation and production tends to be quite skewed (Lotka, 1926). Although the mechanics, and some of the implications, of scientist reputation are analogous to that of journal reputation, the purpose of this paper is somewhat different from the previous literature.[3]

2 Basic model

This section develops a simple theoretical model which includes both the features of *exogenous* horizontal quality and *endogenous* vertical quality (journal reputation). We assume there are two journals and a continuum of authors of papers to be published in those journals. In order to concentrate on the more important issues, we will simplify the part of the model having to do with competition for subscriptions: we assume that a journal's payoff is an increasing function of its quality characteristics (namely its reputation).

Horizontal quality is modelled by assuming that each journal is located at one extreme of a unit segment, and that authors are uniformly distributed along that segment.[4] In each period, two papers are written, one "good" paper and one "bad" paper.[5] The author of each paper is randomly chosen from the unit segment, and submits his or her paper to the journal providing him or her the greatest utility. The utility of a publication in journal i for an author of address j is given by $U_{ij} = r_i - d \mid l_i - a_j \mid$, where r_i is journal i's reputation, d the measure of product differentiation, l_i the location of journal i ($l_1 = 0, l_2 = 1$), and a_j author j's address ($0 \leq a_j \leq 1$).

Each journal can only publish one paper. The "good" paper is always accepted. Rejected papers are resubmitted to a different journal, so that in each period each journal publishes exactly one paper.

We are left with the definition of vertical quality, or journal reputation. Contrary to the existing literature on product differentiation, we consider this to be an endogenous variable. Specifically, we assume that the reputation of journal i in period t, r_{it}, is defined as the *percentage of previously published articles which were "good."* Given this definition, we can econo-

[3]See Dasgupta and David (1990) for a survey and additional references on the "Mathew effect in science."

[4]The assumption of extreme (horizontal) product differentiation is consistent with the industrial organization literature on the Hotelling model. See D'Aspremont, Gabszewicz and Thisse (1979), Economides (1989).

[5]This is obviously a very stylized view of reality. First, the quality of a paper is likely to be a continuous, rather than a discrete, variable. Second, the quality of a paper is frequently judged by its impact in the profession (so "high-impact" should probably substitute for "good"); and the impact of a paper is frequently the result of a dynamic process of difficult ex-ante prediction.

mize on notation by defining $r_{1t} = r_t$ and $r_{2t} = 1 - r_t$. We also assume that $r_0 = 1/2$.

As in the standard Hotelling model, the demand for Journal 1, i.e., the probability that a paper is submitted to Journal 1, is determined by the indifferent author's address. This is the author of address a, where a is such that $r_t - da = 1 - r_t - d(1 - a)$, or

$$a = 1/2 + (2r_t - 1)/d. \tag{1}$$

The probability that a paper will be first submitted to Journal 1, and thus the probability Journal 1 will publish the "good" paper, is denoted by $p(r_t)$ and is equal to the probability that the author's address lies to the left of a. This in turn is given by the right-hand side of (1). Notice that the expression is only valid for $(1-d)/2 \leq r_t \leq (1+d)/2$. Below and above these bounds, the value of $p(r_t)$ is zero and one, respectively. Finally, the demand for Journal 2 equals 1 minus the demand for Journal 1.

The goal of our first simple model is to study the dynamics of the endogenous variable "journal reputation," r_t (and $1 - r_t$). Since the probability that journal i receives a good paper is an increasing function of reputation, and reputation, in turn, is defined as the average number of good articles published in journal i, we conclude that reputation is a self-reinforcing mechanism, that is, a system with positive feedback: the higher reputation is today, the higher is the probability it will increase tomorrow. Specifically, given the structure of the model, the dynamics of r_t have the nature of a Urn scheme of the Pólya kind. It can be shown that if r_t follows a Pólya Urn scheme, then r_t converges almost surely to one of the stable fixed points of $p(r)$ (Hill et al, 1980; Arthur et al, 1983). What are the stable fixed points of $p(r)$? Figures 1 and 2 depict the demand function $p(r)$, as well as the 45° line, for two possible cases, $d < 1$ and $d > 1$. If $d < 1$ (Figure 1), then there exists only one fixed point of $p(r)$, $r = 1/2$. If $d > 1$ (Figure 2), on the contrary, then there exist three fixed points: two stable fixed points ($r = 0$, $r = 1$) and one unstable fixed point ($r = 1/2$). Based on this analysis, we can then prove the following result.

Proposition 1 *If $d < 1$, then reputation is a path-dependent process; the value of r_t converges almost surely to either zero or one.*

In words, if product differentiation is sufficiently small, then one of the journals will eventually have the highest reputation possible and the other one the lowest reputation possible. Therefore, in the long run, all papers are submitted to the high-reputation journal, which in turn publishes "good" articles only. Notice, incidentally, that the long-run equilibrium values of r_t do not depend on the value of d, so long as $d < 1$. (However, the speed of

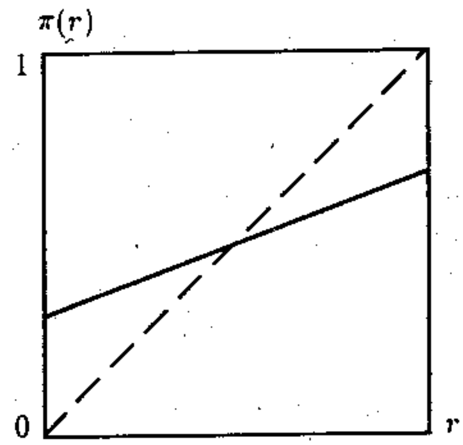

Figure 1: Probability of submission as a function of journal reputation: $d > 1$.

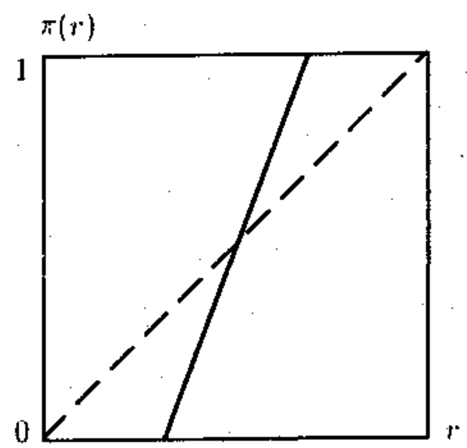

Figure 2: Probability of submission as a function of journal reputation: $d < 1$.

convergence toward the equilibrium will presumably depend on the value of d.)

■ **Noisy refereeing.** One the reasons for an extreme result like Proposition 1 is the assumption that "good" papers are always judged as such by journal editors. We now extend the model by assuming instead that there exists a probability $\epsilon > 0$ that a "good" paper is not judged as such and is thus rejected, which, of course, is only relevant when a journal receives two submissions.[6]

What does noise in refereeing imply for the dynamics of r_t? As before, we are interested in the form of the function $p(r_t)$, which gives the probability that the "good" paper is *published* in Journal 1 as a function of Journal 1's reputation at time t. Due to noisy refereeing, we have to distinguish this function from $f(r_t)$, the probability that the "good" paper is *submitted* to Journal 1. The latter is equal to $p(r_t)$ in the case when $\epsilon = 0$. If on the contrary $\epsilon > 0$, then the new function $p(r_t)$ is given by $f(r_t)$ minus the probability that two papers are sent to Journal 1 and the "good" one is rejected plus the probability that two papers are sent to Journal 2 and the "good" one is, again, rejected:

$$\begin{aligned} p(r_t) &= f(r_t) - \epsilon f(r_t)^2 + \epsilon(1 - f(rt))^2 \\ &= f(r_t) + \epsilon(1 - 2f(r_t)). \end{aligned} \tag{2}$$

Figure 3 shows the effect of noisy referreeing on the shape of $p(r_t)$ (assuming that $d < 1$ and that ϵ is small). As can be seen, the inclusion of ϵ implies a change in the shape of $p(r_t)$. As a result, the values of the stable fixed points are no longer $\{0, 1\}$ but rather $\{\epsilon, 1 - \epsilon\}$. In fact, if ϵ is very high, then the set of equilibrium points collapses to $\{.5\}$. It can be shown that the critical value of ϵ is given by $\overline{\epsilon} = \frac{1-d}{2}$.[7]

These results can be summarized in the following proposition.

Proposition 2 *If $d < 1$ and $\epsilon < \frac{1-d}{2}$, then reputation is a path-dependent process; the value of r_t converges almost surely to ϵ or $1 - \epsilon$.*

In words, Proposition 2 states that if the degree of product differentiation is sufficiently small and if refereeing is not too noisy, then the dynamics of journal reputation are path-dependent: the value of r_t converges almost

[6] Even accounting for noisy refereeing, the way submissions, refereeing, and acceptance decisions are modeled is very simplistic: my main focus here is on the dynamics of journal reputation. For a study of optimal acceptance policies, see Nakamura and Shaffer (1991).

[7] For higher values of ϵ, changes in ϵ have no effect on the values of the limit set (which remains equal to $\{.5\}$). However, different values of ϵ will correspond to different rates of convergence toward the equilibrium.

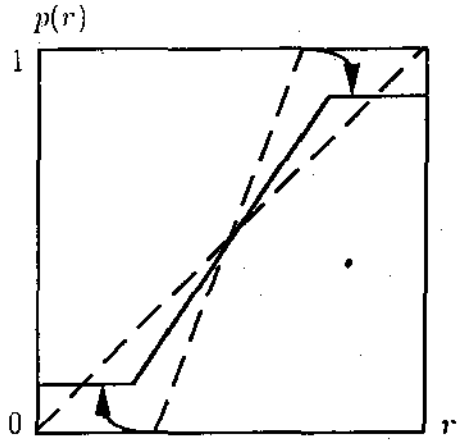

Figure 3: Effect of noisy refereeing on the shape of $p(r)$ (low values of ϵ).

surely to either a very low level (ϵ) or a very high level ($1-\epsilon$), each with probability one half. the particular outcome depending on the particular realization of the first "draws" of papers submitted.

■ **The N-journal case.** The model and the results above can be generalized to the case of N journals. although, as we will see, this is not entirely trivial. One natural way of generalizing the Hotelling model of product differentiation is to consider a "linear city" type of model (Salop, 1979). Specifically, we assume that authors are uniformly distributed along a circle of length one and that journals are located at equal distance from each other. As before. authors choose a journal in order to maximize reputation net of "transport" costs, $r_i - d \mid l_i - a_j \mid$. where r_i is journal i's reputation, d the measure of product differentiation. l_i the location of journal i ($l_i = i/N, i = 1, \ldots, N$). and a_j author j's address ($0 \leq a_j \leq 1$. where 0 and 1 are the same location).

The theorem used in showing Proposition 1 can also be applied here. Let $p = f(r)$, where $p = [p_i]$ is the probability the next paper is submitted to journal i and $r = [r_i]$. r_i being journal i's reputation (the fraction of past papers submitted to journal i). Then. r converges almost surely to a stable fixed point of f. Since the number of potential fixed points is very large (in the case $N = 2$ we only have to consider values of r between 0 and 1), we will concentrate on equilibria where only n equidistant journals survive in the limit, their reputation level being given by $r_i = r = 1/k$, $1 \leq k \leq N$.[8]

The first necessary condition for the proposed r to be a limit point is

[8] We will assume that the total number of journals is large. This implies that there will exist k approximately equidistant journals. if k is not too large, and that approximately halfway betweeen each consecutive pair of journals another journal is located. Accounting for the integer problem makes the analysis substantially more complicated and does not add much to the understanding of the problem. The restriction to the case when surviving journals have the same reputation is also made for convenience of presentation. For empirical evidence on the distribution of journal quality levels, see Brookes (1969).

that it be a fixed point of f. This implies that the probability that a journal equidistant between to consecutive surviving journals receives a submission be zero. (If the probability of submission is zero for this journal, then it will also be zero for any other journal with zero reputation.) In order for this to be the case, we need $1/k \geq 1/(2k)d$, where the right-hand side is the transportation cost to the next surviving journal, or simply $d \leq 2$. Notice that, as a result of the linearity of transportation costs, the condition turns out to be independent of k.[9]

A second necessary condition is that the fixed point be stable, which corresponds to $dp_i/dr_i < 1$. There is a difficulty here, however. The relevant derivative is the *total* derivative of p_i with respect to r_i: when journal i increases the number of "good" papers it publishes, this has an effect on both its own reputation and its rivals' reputation; and p_i is a function of all r_j. Specifically, we have to consider the impact on the neighbor rival journals. Solving the model for the equilibrium probabilities of submission, we get

$$p_i = 1/k - \frac{r_i - (r_{i-1} + r_{i+1})/2}{d}. \tag{3}$$

Now let R_i be the total number of good papers previously submitted to journal i and $R \equiv \sum R_i$. We thus have $r_i = R_i/R$, $\partial r_i/\partial R_i = (R - R_i)/R^2$, $\partial r_j/\partial R_i = -R_j/R^2$, and

$$\frac{\partial r_j/\partial R_i}{\partial r_i/\partial R_i} = -\frac{R_j}{R - R_i} = \frac{r_j}{1 - r_i}. \tag{4}$$

Finally, we get

$$\frac{dp_i}{dr_i} = \frac{\partial p_i}{\partial r_i} - \sum_{j \neq i} \frac{\partial p_i}{\partial r_j}\frac{dr_j}{dr_i} = \frac{1 + \alpha_i}{d}, \tag{5}$$

where

$$\alpha_i \equiv \frac{1}{2}\left(\frac{dr_{i+1}}{dr_i} - \frac{dr_{i-1}}{dr_i}\right) = \frac{1}{2}\left(\frac{r_{i+1} + r_{i-1}}{1 - r_i}\right). \tag{6}$$

In particular, since we are considering the case when all surviving journals have the same reputation level $1/k$, $\alpha = 1/(k-1)$ and $dp_i/dr_i = k/((k-1)d)$. Stability then requires $d > k/(k-1)$. The above facts can be summarized in the following result.

Proposition 3 *If $k/(k-1) < d < 2$, then r converges with positive probability to a vector with $r_i = 1/k$ for each of k equidistant journals and $r_i = 0$ otherwise.*

[9] The fact the critical limit for d is different from the two-journal case ($d = 2$ instead of $d = 1$) is due to the fact we are considering a circle model and not a line model. The two models are however consistent when we consider the condition in terms of the derivative of p_i with respect to r_i (see below).

Notice that this result does not say much about the set of possible limit equilibria (which in principle could include even more uneven values of r) or about the probability that each limiting r is reached in equilibrium. (However, by symmetry, we know it has to be the same for all the r in Proposition 3.)

3 Data analysis

In this section, we present some preliminary data analysis to test the results presented in Section 2. The analysis is based on citation data from economics periodicals, on the assumption that citations reflect journal quality.[10]

Obviously, the model presented in Section 2, where reputation is given by the fraction of "good" papers previously published, is a very stylized model. In practice, journal articles cannot be divided into "good" and "bad" articles that simply. The solution we adopt here is to assume that the total number of citations, corrected for journal size, is a good measure of the probability of publishing a "good" paper.[11]

Specifically, we define two periods. Period 1 includes the decade 1968–1977, and period 2 the decade 1978–1987. As an index of the number of good papers published in journal i during period t, we use the number of end year (1977 for $t = 1$, 1987 for $t = 2$) citations to papers published during that period (q'_{it}), corrected for journal size during that period (s_{it}). So, for example, q_{i1} will be the number of citations found in 1977 articles (in any journal) to articles published in journal i during the period 1968–1977.

The reputation of journal i by period t, on the other hand, is measured by the number of end-year citations to papers published *before* the beginning of the period ((r'_{it}), again corrected for journal size (s_{it}). Notice that, implicitly, we are making the assumption that authors have perfect foresight regarding the quality of published articles. It would have been better to simply use the number of 1967 citations to papers published before 1968 (in the case of reputation in the first period). However, these data are not available.

Finally, since the model is written in terms of fractions and probabilities, we normalize both variables as ratios to the total across all journals. This yields the series q_{it} and r_{it}, defined as

[10] We are thus ignoring the process of reputation formation for individual journal articles, a process which arguably is also based on some form of cumulative causation. A complete model would however become too complex. Moreover, in dealing with large numbers, we can expect path-dependence effects at the individual article level to "average out" for each journal, so that the total number of citations is a good indicator for reputation.

[11] The measure will be exact if a "good" paper is defined as a paper with more than n citations and the distribution of the number of citations is constant across journals and across time. For a study of the distribution of the number of citations to science journal articles, see Price (1965).

$$q_{it} \equiv \frac{q'_{it}/s_{it}}{\sum_{j=1}^{N} q'_{jt}/s_{jt}}, \qquad (7)$$

$$r_{it} \equiv \frac{r'_{it}/s_{it}}{\sum_{j=1}^{N} r'_{jt}/s_{jt}}. \qquad (8)$$

where N is the number of journals in the sample.

We would like to estimate an equation of the form

$$q_{it} = g(r_{it}, z_{it}) \qquad (9)$$

where z_{it} is a vector of factors (other than reputation) which affect the quality of the journal (reputation in a broader sense), e.g., the quality of the editorial board. The problem with this specification is that it is very difficult to identify the relevant elements of z_{it}, let alone to measure them.

In order to get an estimable equation, one has to make some assumptions. First, we will assume that $g(.)$ is linear (in the relevant range). Second, and more important, we assume that the exogenous variables z are constant in time:

$$q_{it} = \alpha + \beta r_{it} + \gamma z_i + \epsilon_{it} \qquad (10)$$

from which we get

$$\Delta q_i = \beta(\Delta r_i) + \nu_i \qquad (11)$$

where $\Delta q_i \equiv q_{i2} - q_{i1}, \Delta r_i \equiv r_{i2} - r_{i1}$, and $\nu_i \equiv \epsilon_{i2} - \epsilon_{i1}$.

We constructed a sample of data based on the *Social Science Citation Index* (SSCI). The criteria for including journals in the sample were (i) that the journal be classified by SSCI as an economics journal and listed in both the 1977 and 1987 volumes; (ii) that its first year of publication be 1964 or before; and (iii) that English be its main language. This process resulted in a sample of 40 journals which are listed in the Appendix, along with the data for q'_{it}, r'_{it} and s_{it}.

The values of $\Delta q_i \equiv q_{i2} - q_{i1}$ and $\Delta r_i \equiv r_{i2} - r_{i1}$ are plotted in Figure 4. Direct inspection reveals that there is a clear outlier, the *Journal of Economic Literature*. The reason is that *JEL* publishes a very small number of articles compared with the other journals. Besides this disparity, there are other good reasons why one may want to exclude *JEL* from the sample: first, it does not publish unsolicited papers; second, its main purpose is not so much to publish articles as to review and index the literature.

We thus considered the sub-sample consisting of the remaining 39 journals. The values of $\Delta q_i \equiv q_{i2} - q_{i1}$ and $\Delta r_i \equiv r_{i2} - r_{i1}$ were re-plotted on a larger scale and, as Figure 5 shows, two other outliers can be identified:

Table 1: OLS regression results

Sample	β	t-stat
All 40 journals	0.544	10.33
J.E.L. excluded	0.700	9.70
J.E.L., J.P.E. and Econometrica excluded	0.704	15.07

Econometrica and the *Journal of Political Economy.* Although there is no particular economic reason why one should exclude these from the sample, we also performed a regression on the smaller sample of 37 journals.

The results of the least squares regressions of (11) are shown in Table 1. All estimates of β are significantly different from zero, denoting that journal reputation is indeed a self-reinforcing process. It is interesting to note that the estimate of β does not change much across different samples.

What does the value of β tell us about the value of d? From Section 2, we know that

$$\beta_i \equiv \frac{dp_i}{dr_i} = \frac{1+\alpha_i}{d}. \tag{12}$$

where

$$\alpha = \frac{1}{2}\left(\frac{r_{i+1}+r_{i-1}}{1-r_i}\right). \tag{13}$$

Now, since we do not know the exact locations of each journal, we cannot get the exact values of each α_i. We can, however, find bounds for the values of α_i. Let $\underline{\alpha}$ and $\overline{\alpha}$ be the lowest and the highest possible values of α. Then, we get that

$$\frac{1+\underline{\alpha}}{\beta} \leq d \leq \frac{1+\overline{\alpha}}{\beta} \tag{14}$$

Finally, based on the sample values for α and the estimate for β (39 journal sample) we get

$$1.429 < d < 1.680. \tag{15}$$

From Proposition 3, this implies that the set of positive probability limit equilibria includes those with k surviving journals of equal reputation, for $k = 1, 4, 5, ..., 39$ and possibly $k = 3$.[12]

[12]From Proposition 3, one can see that $k = 2$ is never a limit equilibrium. Therefore, the only possibility excluded by the data is $k = 3$.

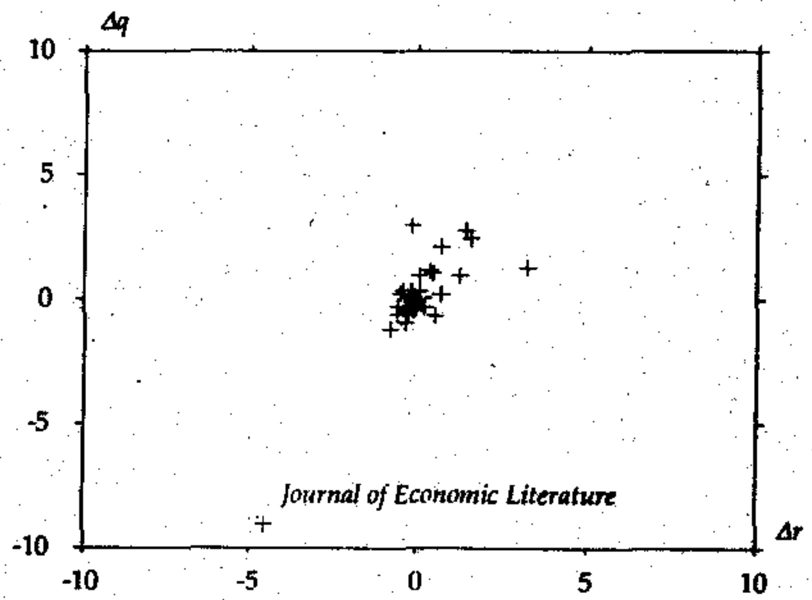

Figure 4: Variation of quality of submissions (Δq) and variation of reputation (Δr) for 40 leading economics journals. Period 1 is 1968–1977 and period 2 1978–1987.

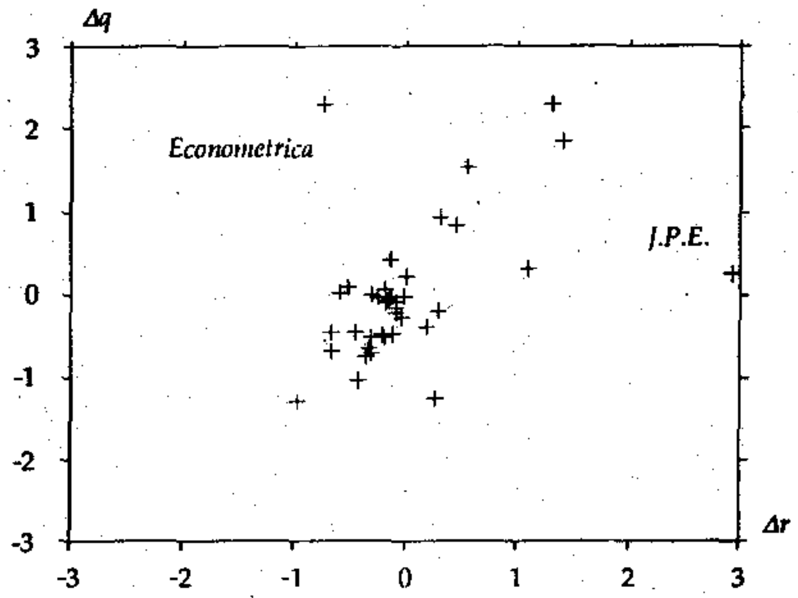

Figure 5: Variation of quality of submissions (Δq) and variation of reputation (Δr) for 39 leading economics journals (*JEL* excluded). Period 1 is 1968–1977 and period 2 1978–1987.

4 Implications

Up to this point, we have considered two aspects of product differentiation: (i) journal reputation (vertical quality) and (ii) location in the space of product attributes (horizontal quality). However, there is one additional aspect which characterizes a journal, and that is its scope: there are more general and more specialized journals. In this section, we explore some of the possible implications of journal reputation as a path-dependent process in terms of the strategic choice of scope.

In general terms, both a narrow and a wide scope have their own advantages from a publisher's perspective: a wider-scope journal covers a potentially larger audience, whereas the willingness to pay for a specialized journal may be greater for those who are interested in that particular specialty. The point we want to make is that the path-dependence nature of journal reputation will likely imply a bias toward an increased degree of specialization.

We consider a simple model in which two publishers sequentially choose the scope of their journal, which can either be "general" or "specialized."[13] Each journal's payoff is a function of the pattern of submissions, which in turn depends on the scope and reputation of both journals. Specifically, a journal's payoff is equal to the expected probability of having the "good" paper submitted to that journal.

The trade-off between specialization and reputation, from an author's point of view, is modelled by assuming lexicographic preferences. A fraction μ of authors prefer to publish in a specialized journal of their area; the remaining $1-\mu$ prefer to publish in the journal with the highest reputation. If both journals score the same with regards to the first-order characteristic, than the second one is compared. Finally, if both journal are equal in scope and reputation, then submissions are based on the toss of a fair coin.

Let us first consider the case when reputation does not matter, that is, assume that each journal's reputation is equal to 0.5 regardless of that journal's publication record. Under these assumptions, it is easy to see that payoffs are independent of the firms' choices of scope (except for the case when both firms choose a specialized journal in the same area, which would never occur in equilibrium).

Now suppose that reputation matters and that it is a path-dependent process. The extreme case when there is no noise in refereeing implies a strong first-mover advantage. This can be seen from Figure 6, which depicts the extensive form of the sequential game played by the two publishers. If both publishers choose a general journal, then journals only differ with regards to reputation and the first-mover advantage is decisive. The first

[13]Brander and Eaton (1984) also consider a model where firms choose the scope of their product line. They consider the case of simultaneous choice and a somewhat different notion of scope.

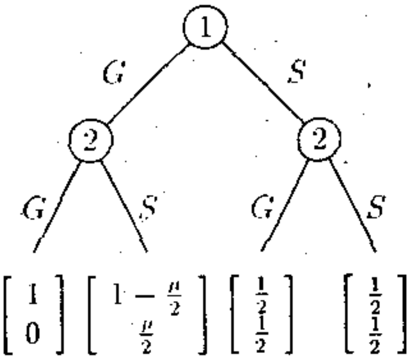

Figure 6: Sequencial choice of scope: extensive form.

journal, having published only "good" articles during its life as a monopolist, starts off phase two with the highest reputation possible. Since reputation is a self-reinforcing mechanism, and $p(1) = 1$, the second journal will never have an opportunity to compete with the first, and thus payoffs will be $(1, 0)$. If, on the contrary, the second publisher chooses to have a specialized journal, then it will be able to capture a fraction $\mu/2$ of authors, those who prefer a specialized journal and are interested in that journal's area of specialization.

It can be easily seen from Figure 6 that G (for "general") is a dominant strategy for the first publisher and that (G, S) is the unique Nash equilibrium of this game:

Proposition 4 ***If journal reputation is a path-dependent process, then, in equilibrium, the first mover chooses a general journal and the second mover chooses a specialized journal.***

The intuition for this result is that specialization is the only alternative by which the second comer can oppose to the first mover's advantage in terms of higher reputation.

Notice that while we have assumed journal reputation to be a path dependent process, a similar result will hold as long as the self-reinforcing nature of journal reputation is significant. In the latter case, however, we would have to consider interim payoffs before convergence to the long-run levels of journal reputation, which makes the analysis much more complicated.

■ To conclude, we consider the implication of increased specialization in terms of the number of periodicals in the market. Suppose there is free entry into the market for periodicals and that a journal's profit is an increasing function of its reputation (the fraction of "good" articles it publishes). Initially, all journals are general, and in a second phase all new journals are specialized, which is consistent with the analysis above. Since free entry implies zero *ex-ante expected* profits and the risk of a flop is greater for general journals, ex-post profits for *surviving* general journals should be greater than for specialized ones. Since profits are by assumption an increasing function of reputation, it follows that the reputation of surviving general journals should be greater than that of specialized journals.

Now, if the reputation of specialized journals, that is, the fraction of "good" articles they publish, is lower than their predecessors', then the average fraction of "good" articles per journal is decreasing all along the second phase (of entry by specialized journals). This in turn implies that the number of new journals is increasing faster than the number of papers (assuming the fraction of "good" papers in total remains constant). That is, we have identified an endogenous factor which explains the growth in the number of periodicals which is independent of the exogenous factors which explain the increase in the total number of papers written.

5 Final remarks

The number of professional publications, especially professional periodicals, has increased dramatically in recent years. At the same time, each new journal seems to be increasingly specialized. We have looked at the journal publishing activity from an industrial organization perspective and provided an explanation for how the observed trends might result from the endogenous working of the periodicals "market." Specifically, we have shown that if journal reputation is a path-dependent process, then there is a bias towards specialization in the strategic choice of journal scope. Empirical evidence suggests that journal reputation is indeed a path-dependent process.

Evidently, we did not attempt to provide a complete explanation of reality. There are certainly many factors which explain the growth in research output in terms of number of papers written. These in turn would be an obvious way of explaining the growth in the number of periodicals. Our results imply, however, that the growth in the number of periodicals is greater than the growth in research output, and thus provide an additional explanatory factor. The empirical test of this conjecture is a natural step to follow.

Appendix

The data used for the regressions reported in Section 3 is presented in the following table. The sources used were the 1977 and 1987 volumes of the *Social Science Citation Index*, Institute for Scientific Information, Philadelphia. See Section III (Definitions) of the referred document for details.

Journal name	q_1'	r_1'	q_2'	r_2'	s_1	s_2
ACTA OECON	13	1	41	3	81	83
AM ECON REV	3822	1227	5605	2732	331	368
AM J AGR ECON	500	8	972	302	281	315
AM J ECON SOCIOL	66	24	102	33	70	90
AUST ECON PAP	3	0	52	23	52	55
CAN J ECON	317	126	418	119	83	112
DEV ECON	16	3	33	6	49	43
ECON DEV CULT CHANGE	32	16	469	202	82	73
ECON GEOGR	263	86	241	103	54	38
ECON HIST REV	274	146	550	279	66	64
ECON INQ	103	0	407	119	93	93
ECON J	1093	531	1484	783	106	143
ECON REC	99	50	132	62	83	60
ECONOMETRICA	2295	1166	4275	1859	184	161
ECONOMICA	595	326	724	451	64	74
EXPLOR ECON HIST	102	6	206	60	41	32
J AGR ECON	83	17	143	44	46	64
J ECON BUS	30	7	88	28	73	58
J ECON HIST	332	128	588	240	79	109
J ECON LIT	383	2	724	208	23	20
J ECON STUD	10	1	14	2	28	44
J IND ECON	137	40	288	84	46	65
J LAW ECON	467	175	1103	532	57	50

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Journal name	q_1'	r_1'	q_2'	r_2'	s_1	s_2
J POLIT ECON	2780	1113	4080	2350	161	132
J TAX	250	24	146	24	398	699
KYKLOS	183	50	215	111	83	49
LAND ECON	266	108	427	140	82	99
MANCH SCH ECON SOC	177	89	129	84	37	45
NATL TAX J	440	141	455	189	92	109
OXFORD B ECON STAT	80	18	168	53	46	50
OXFORD ECON PAP	277	108	419	160	52	103
PUBLIC FINANC	72	21	105	42	50	61
Q J ECON	1220	610	1789	1029	113	120
Q REV ECON BUS	80	6	75	26	81	61
REV ECON STAT	1511	634	1854	832	163	200
REV ECON STUD	1249	510	1551	854	115	103
REV SOC ECON	36	1	74	22	28	36
S AFR J ECON	38	11	67	24	60	65
SCOT J POLIT ECON	115	27	132	40	37	52
SOUTHERN ECON J	414	95	537	174	158	196
TOTAL	20223	7652	30882	14428	3828	4394

Key to variables:

q_1': 1977 citations to articles in 1968–1977 period;
r_1': 1977 citations to articles prior to 1968;
q_2': 1987 citations to articles in 1978–1987 period;
r_2': 1987 citations to articles prior to 1978;
s_1: Number of source items in 1975–76;
s_2: Number of source items in 1985–86;

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